

# Thermal and Optical Characterization of an Integrated Alpha Level Source, Debris Mitigation and Collector System

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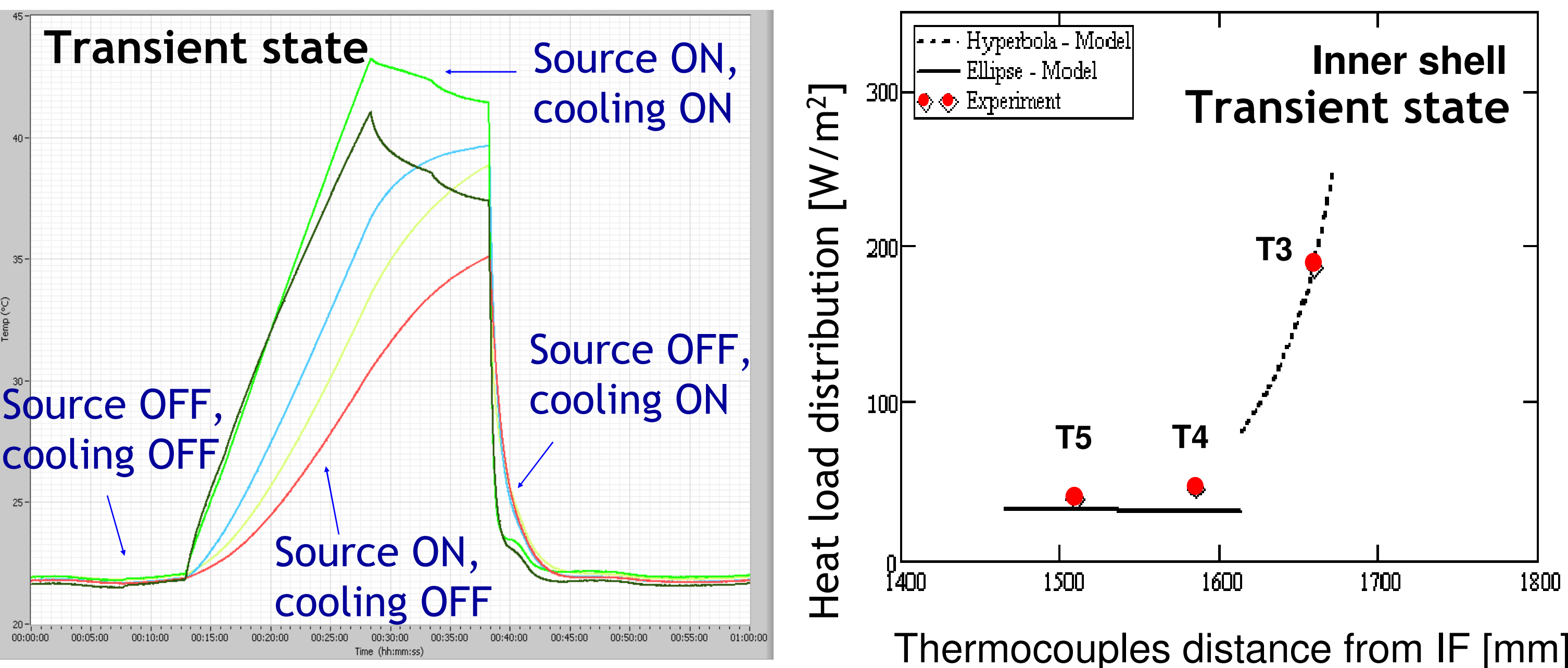
## Introduction

Dual mirror alpha grazing incidence collectors produced by Media Lario Technologies are integrated into a Sn-fueled GDPP source test stand at Philips Extreme UV. Next to source and debris mitigation development, the accurate temperature mapping of the collectors lead to the development of a validated power budget scalable to high volume manufacturing configurations. Optical stability of the system is quantified through extra-focal imaging metrology.

## Collector thermal management

The validation of the thermal behaviour of the collectors at 1.0 kW/2 $\pi$  sr total radiated power is achieved through extensive temperature measurements on the mirrors and the supporting structure and by monitoring the cooling water temperature and flow.

**Transient state test** is needed to measure the local heat load on the mirrors.

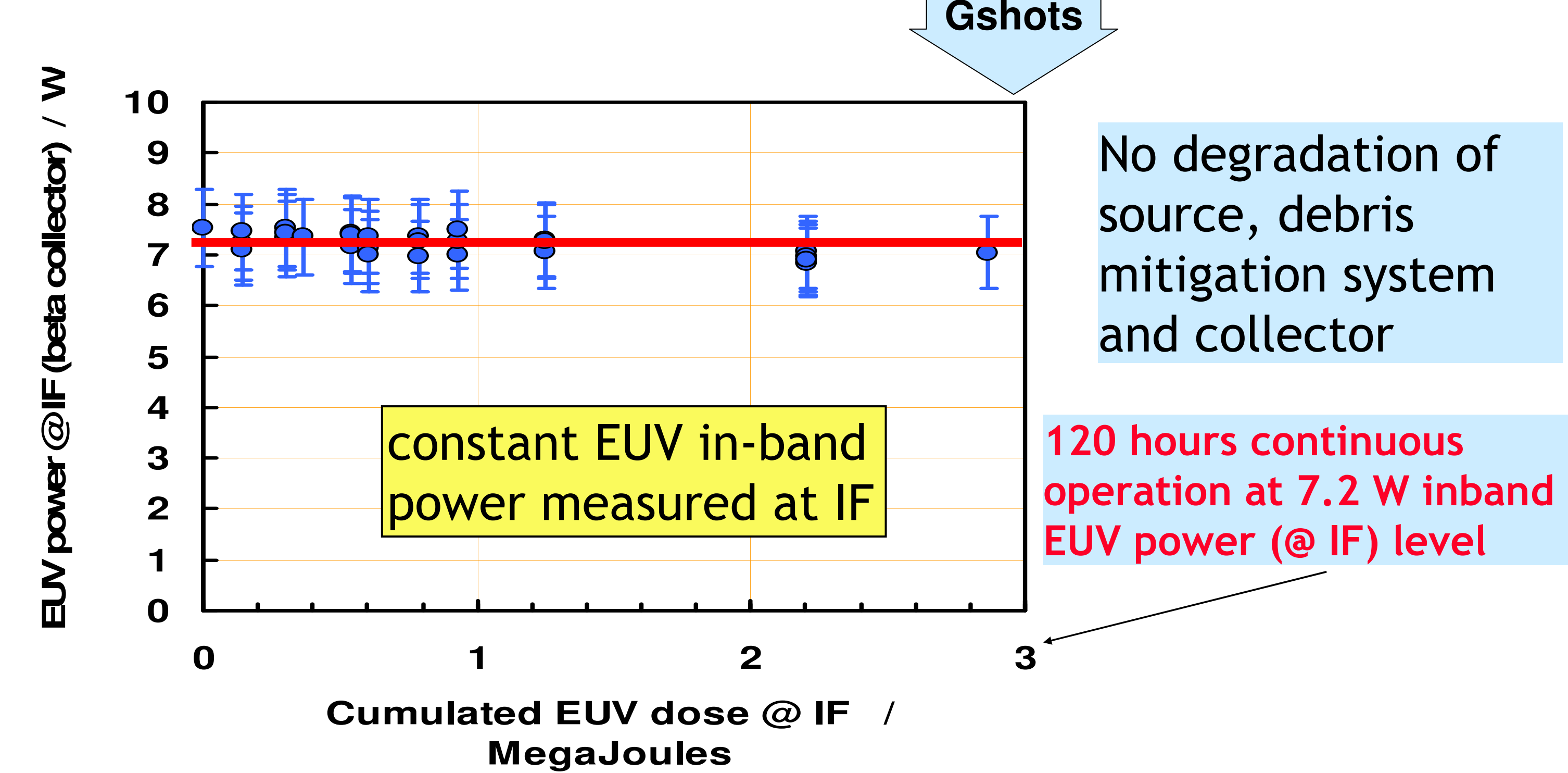


**Steady state test** provides the thermal budget information to validate the model (cooling operational as per design).

The cooling capacity of the optics is matching the modeling. This modeling can be used for further scaling, which will be validated by additional experiments

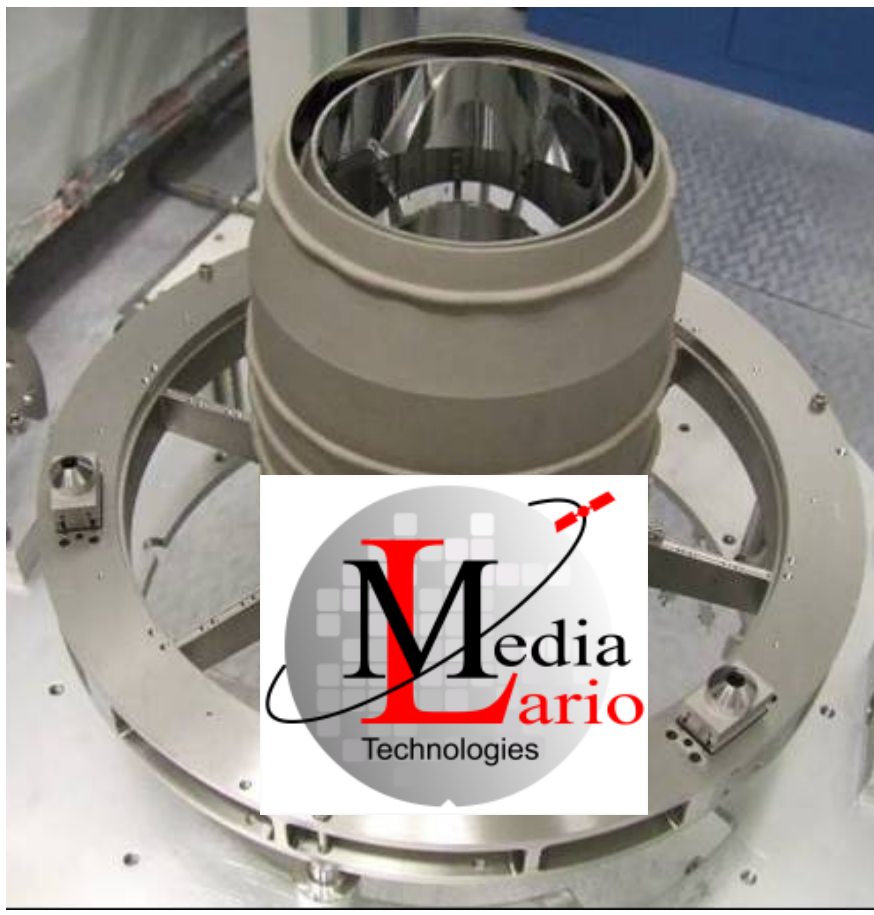
Steady state		Simulated	Measured	Diff.
Outer shell top	T1	23.2	23.7	0.5
Outer shell bottom	T2	22.4	22.2	-0.1
Inner shell top	T3	23.0	24.1	1.2
Inner shell middle	T4	22.1	22.6	0.6
Inner shell bottom	T5	22.1	22.4	0.4
Cooling capacity		26.0	30.0	4.0

## Lifetime



## Test stand setup

Media Lario 2-shells grazing incidence collector with thermal management system

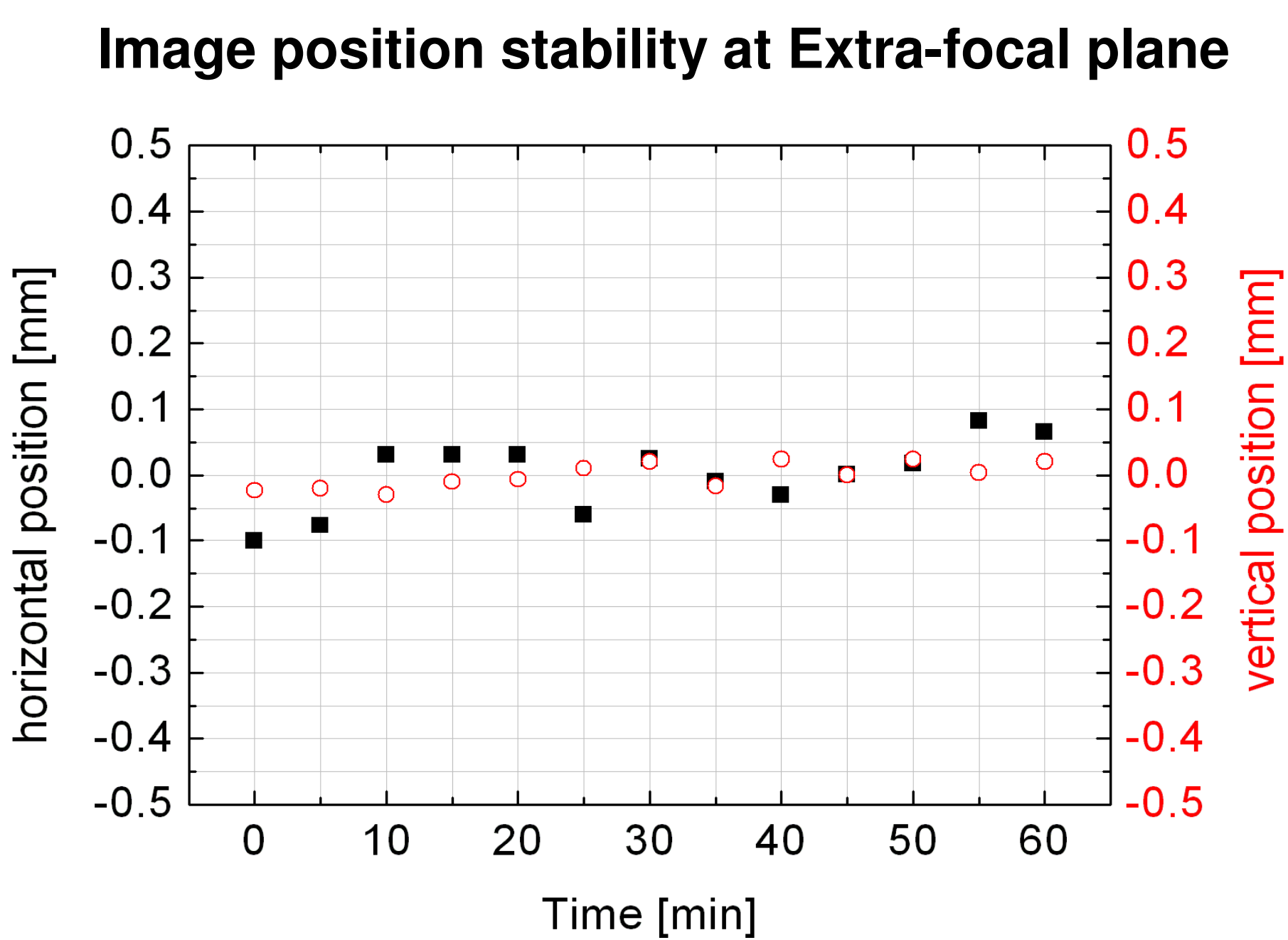
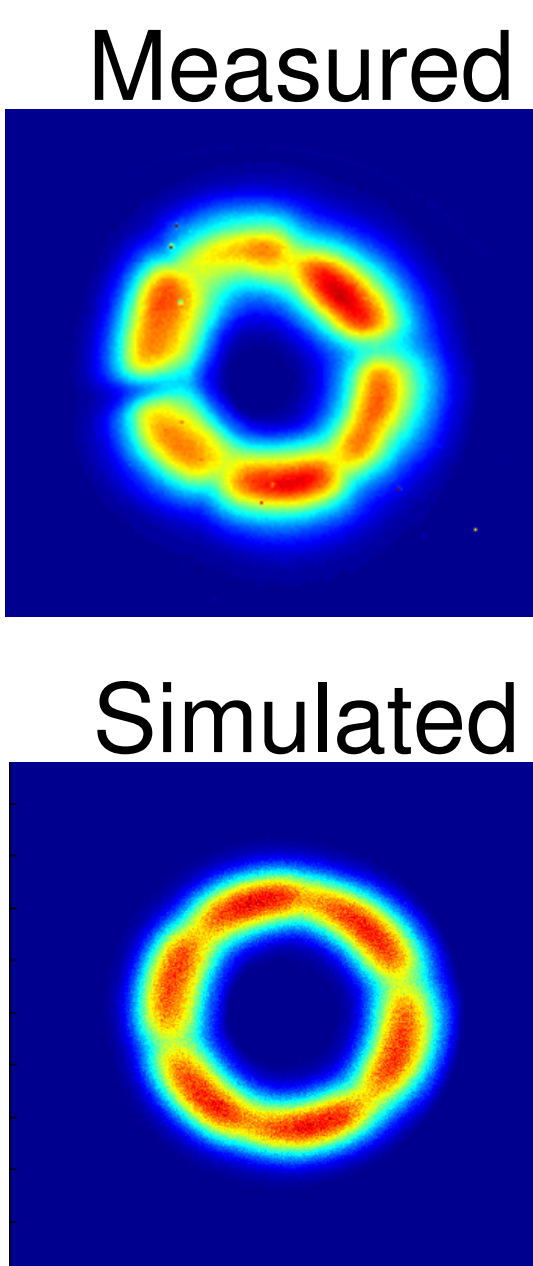


Philips Sn DPP source



Philips Debris Mitigation system (DMT)

## Extra-focal plane (200 mm from IF)



## Conclusions

- Complete Sn-fueled DPP SoCoMo fully integrated and functional
- Thermal behavior of the collector optics in good agreement with the simulation
- Stable optical performance proven at extra-focal plane
- 120 hours (1 Gshots DPP pulses) of lifetime in continuous operation demonstrated for the full SoCoMo

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